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ABSTRACT

The design and initial trial phase of a project to develop a computer-based budget planning system for school districts are reported in this document. From a teletype at the district office linked to a computer at System Development Corporation, a user (administrator) can retrieve specific portions or summaries of a prestored description of his personnel. In addition, an administrator can prepare alternative budgets at the teletype by modifying factors such as the salary base of the salary schedule. Analyses of data and observational notes indicate the need to incorporate this system more directly into the budget planning cycle by providing information regularly to administrators and to delete the interactive (teletype) capability. Administrators making planning decisions can readily tolerate several days' delay in obtaining the results of those decisions. (Author/DN)

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TECHNICAL MEMORANDUM

(TM Series)

The research and development reported herein were performed pursuant to contract dated 16 June 1966 with the Southwest Regional Laboratory for Educational Research and Development, for a Computer-Based Educational System.

Progress Report: The Development of a School District Budget Planning System (SPLAN)

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ABSTRACT

The design and initial trial phases of a project to develop SPLAN (pronounced "es-plan")--a computer-based budget planning system for school districts--are reported in this document. The work described was accomplished during the period 1 March 1967 through 29 February 1968.

An initial version of SPLAN was made available to administrators at Charter Oak Unified School District from May 1967 until the present. SPLAN offers the user two capabilities: from a teletype at the district office linked to a computer at System Development Corporation, the user can retrieve specific portions or summaries of a prestored description of his personnel; in addition, the user can prepare alternative budgets at the teletype by modifying factors such as the salary base, salary schedule, etc.

Analyses of data and observational notes indicate the need for two revisions to SPLAN. One is to incorporate SPLAN more directly into the budget planning cycle by regularly providing information to administrators. The other is to delete the interactive (teletype) capability; administrators making planning decisions can readily tolerate several days' delay in obtaining the results of those decisions.

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I. INTRODUCTION

School administrators are often prevented from pursuing more than a single budget plan by the sheer mechanics of gathering factual data. By the time an alternative approach is formulated into a plan, the plan subsequently explained to a clerk, and the clerk in turn searches the files for supporting data, the administrator's enthusiasm for the idea has frequently disappeared. After a few such experiences, planners find themselves giving serious consideration to only a single budget possibility forced to their attention by salary committees or school boards. Thus, budget planning tends to be a process of rationalizing a single set of forced conditions rather than a process in which the staff takes the initiative to create and analyze a set of alternative plans that can be judged in terms of their educational desirability.

To aid school administrators in budget planning, System Development Corporation (SDC) is developing a computer-based system called SPLAN (pronounced "es-plan"). The system is being prepared under a contract with the Southwest Regional Laboratory for Educational Research and Development (SWRL). An experimental version is currently operating at the district office of Charter Oak Unified School District in Covina, California. District data are processed by the Q-32 computer operating in a time-shared mode at SDC. The computer is connected by telephone line to a teletypewriter located in the district office, to permit school administrators to obtain timely listings of budget and related data.

The current operating version of SPLAN was designed to provide administrators with a working program that could systematically evolve, through successive empirical trials and revisions, into a practical and useful budget planning aid. Our experience to date in the operation of SPLAN has shown that certain features in the original design are unnecessary and that other features should be added. These findings, and some of the planned modifications to SPLAN, are discussed in later sections of this report.

This document constitutes the SPLAN portion of the final report to SWRL of the SDC work accomplished during the period 1 March 1967 through 29 February 1968.

II. GENERAL DESCRIPTION OF SPLAN

SPLAN gives a budget center, such as a school district office, two capabilities. In one use, a district can store in and retrieve from the system data describing the district's personnel. Administrators can request from this personnel file a variety of information that is limited only by the amount of clerical time a district will afford to assemble the file. The SPLAN program will count, add, average, sort, locate minima and maxima, and print any combination of information from this file that can be composed with a general-purpose query language available to the user. Moreover, the program immediately responds to the administrators' questions as they are typed at the district office.

In the second use, SPLAN provides the capability for calculating a budget to produce selected lines for the California J-41 Budget Report form. The selected lines describe the current expenses of the district and include most of the cost of instruction. One subset of these lines requires that the administrator estimate the values and enter these directly; another subset is computed by the program from the personnel data base, using descriptions of the district's salary schedule, salary indices, and salary factors.

Examples of the two uses of SPLAN are displayed in Figures 1 and 2. The figures are representations of actual teletype outputs that required about 20 minutes to produce while sharing the Q-32 computer with 20 to 25 other users. The messages shown in these figures are the interactions between the user (who inputs his commands on the teletype) and SPLAN (which causes the teletype to print its response).

The dialogue reproduced in Figure 1 is the result of an attempt to assess the effects of teacher retirement on next year's budget and on teacher replacement. Figure 2 shows the effect of a proposed general raise for the total certificated staff. The figures illustrate how the user can work to a solution as he obtains information, selects what he needs, and reinserts the results of his selections into SPLAN.

In the example shown in Figure 1, the user has asked for a count of the number of teachers in his data base who have reached retirement age (COUNT WHERE JOB-TITLE EQ TEACHER AND AGE GQ 65). There are two teachers who are at retirement age (2 ENTRIES). The user then asks for specific information about them (PRINT NAME, STEP, DEGREE, HOURS-PLUS, SUBJECT-AREA, SCHOOL WHERE SAME); notice that he can use the specifications of his previous command by using the word SAME. Mary Jones is one of the two retiring teachers. She holds a bachelor's degree, teaches third grade at Willow School, and is on the seventh step of the current salary schedule. With the command SUM SALARY WHERE SAME, the user also finds that the total salary of the two retiring teachers is $16,040.

The user realizes that Hazel Henry, the second of the two teachers, is leaving an assignment (SP-ED) for which there might be difficulty in finding a replacement. He enters another request (COUNT WHERE JOB-TITLE, etc.) that will tell him how many possible replacements there are for Hazel Henry and discovers there are two (2 ENTRIES). He next asks for amplifying information on these two teachers so that he can consider their possible transfer.

Figure 2, a continuation of the planning session, illustrates some of the capabilities of the initial version of the budget capability of SPLAN. The first command in Figure 2, BUDGET, causes the program to calculate the budget on the basis of the data present in the district's data base. When the calculations are complete, SPLAN indicates that the budget has been calculated by using the message BUDGET READY IN T1. T1 refers to Table 1, which contains current expense items on the budget. Next, the user requests a printout of the line that represents the cost of teachers' salaries: PRINT T1 213 ALL. The response shows that teachers' salaries for this year are $2,354,500.

```
 NEXT?
COMMAND WHERE JOB-TITLE EQ TEACHER AND AGE GQ 65
 ----
2 ENTRIES
 NEXT?
PRINT NAME, STEP, DEGREE, HOURS-PLUS, SUBJECT-AREA, SCHOOL WHERE SAME
 ----
 NAME                  STEP  DEG  HOURS  SUBJECT-AREA  SCHOOL
                             REE  -PLUS
 JONES, MARY L            7  B      26  THIRD         WILLOW
 HENRY, HAZEL T           6  B      45  SP-ED         PALM-VIEW
 NEXT?
SUM SALARY WHERE SAME
 ----
 SUM SALARY  16ø4ø
 NEXT?
COUNT WHERE JOB-TITLE EQ TEACHER AND CREDENTIALS EQ EX-CH-MR *
 * AND SUBJECT-AREA NQ SP-ED
 ----
 2 ENTRIES
 NEXT?
PRINT NAME, SCHOOL, SUBJECT-AREA WHERE SAME
 ----
 NAME                  SCHOOL          SUBJECT-AREA
 BROWN, LORNA M        WASHINGTON      FOURTH
 SMITH, JERRY T        ROYAL-OAK-HS    HISTORY
                                       YR-BOOK
 NEXT?
```

Figure 1. Printout Showing Interaction Between User and SPLAN Storage and Retrieval Capability

```
READY.
BUDGET
BUDGET READY IN T1.
READY.
PRINT T1 213 ALL
              TITLE                    THIS       NEXT       DIF

 213    TEACHERS' SALARIES            2354ØØØ    2354ØØØ       -Ø
READY.
PRINT T5 ALL
          A     B     C     D     E     F     G     H     I     J      SUM

   1      4     7     Ø     Ø     Ø     Ø     Ø     Ø     Ø     Ø       11
   2      5     7     5     Ø     Ø     Ø     Ø     Ø     Ø     Ø       17
   3     14     5     4     5     Ø     Ø     Ø     Ø     Ø     Ø       28
   4     1Ø     9     1Ø    2     Ø     Ø     Ø     Ø     Ø     Ø       31
   5     14     8     1Ø    3     Ø     Ø     Ø     Ø     Ø     Ø       35
   6     15     8     4     9     Ø     Ø     Ø     Ø     Ø     Ø       36
   7      4     2     8     5     Ø     Ø     Ø     Ø     Ø     Ø       19
   8      6     4     5     4     Ø     Ø     Ø     Ø     Ø     Ø       19
   9      3     8     7     5     Ø     Ø     Ø     Ø     Ø     Ø       23
  1Ø     16    13     3     7     Ø     Ø     Ø     Ø     Ø     Ø       39
  11      Ø     Ø    18     4     Ø     Ø     Ø     Ø     Ø     Ø       22
  12      Ø     Ø     Ø     9     Ø     Ø     Ø     Ø     Ø     Ø        9
   T     91    71    74    53                                          289
READY.
MAKE T5 7 B EQ VALUE - 1
READY.
MAKE T5 6 C EQ VALUE - 1
READY.
MAKE T5 1 A EQ VALUE + 2
READY.
MAKE T5 1 B EQ VALUE + 1
READY.
MAKE T5 2 A EQ VALUE + 2
READY.
MAKE T4A 1 BASE EQ VALUE + 3ØØ
READY.
BUDGET
BUDGET READY IN T1.
READY.
PRINT T1 213 ALL
              TITLE                    THIS       NEXT       DIF

 213    TEACHERS' SALARIES            2354ØØØ    2495Ø1Ø    14Ø51Ø
READY.
```

Figure 2. Printout Showing Interaction Between User and SPLAN Budget Program

Table 1. Increase in Personnel Costs for Different Salary Proposals

	Proposal A Base $6000	Proposal B Base $6050	Proposal C Base $6100	Proposal D Base $6150	Proposal E Base $6200
Hand Method (Old Indices)	$123,017	$147,790	$168,138	$193,090	$ ---
SPLAN (Old Indices)	122,780	147,332	171,888	196,443	220,998
Hand Method (New Indices)	---	---	---	---	266,613*
SPLAN (New Indices)	159,451	184,310	209,172	234,032	258,893**

*Includes eight additional steps on the salary schedule.

**Does not include the eight additional steps.

The user then asks PRINT T5 ALL for a copy of the table (T5) showing the distribution of teachers on the existing salary schedule. His next two commands request that appropriate decreases be made in table T5 to reflect the retirement of teachers as reported in Figure 1. The retiring teachers are located in Row 7, Column B, and Row 6, Column C. He also adds to the distribution three teachers, representing planned new hires for next year. The increases and decreases to the distribution table all use commands beginning with MAKE.

The user next decides to see what effect increasing the base salary by $300 will have on the entire cost of teachers' salaries. The base salary amount is stored in table T4A. The command MAKE T4A 1 BASE EQ VALUE + 300 causes the program to make the increase to the base salary amount. The result of this increase takes effect when the user enters BUDGET: SPLAN then recalculates the budget and reports BUDGET READY IN T1. The user can now examine next year's potential cost in line 213 by repeating the command PRINT T1 213 ALL. Notice in Figure 2 that the output not only shows the next year's cost (NEXT), but also shows a comparison with this year's amount (DIF). The user knows from DIF that his suggested changes will increase this line of his budget by more than $140,000.

III. GENERAL STAGES IN SPLAN DEVELOPMENT

Although this report is concerned primarily with the contract period from 1 March 1967 through 29 February 1968, the longer-term phasing and objectives of the SPLAN project are outlined below to provide context for the subsequent discussion.

A. SPLAN Q-32 STAGE--June 1966-March 1968

Activity: Produce for the Q-32 computer and install at Charter Oak School District a general purpose information processing tool adapted for budget planning.

Purposes: Collect user reactions as aid in designing Budget Planning System.

Train district personnel in using information for planning.

Products: TM-3362/001/00, 3/13/67, Directions for Filling Out the District Data Base Forms for SPLAN.

TM-3362/002/01, 9/19/67, Description of the Basic Budget Planning Tables for SPLAN.

TM-3362/003/00, 10/5/67, SPLAN: Program Description.

SPLAN computer program written in the JTS language for operation on Q-32 Time-Sharing System.

Observational Notes. About 90 pages of notes were collected during 30 to 40 visits to the Charter Oak district office. These notes provide a background for defining SPLAN II.

B. BUDGET PLANNING PROCESS DEFINITION STAGE--August 1967-August 1968

Activities: Observe the behavior of Charter Oak administrators during budget planning cycle to define the specific information that is required. In addition, project personnel actively consult with district officers in regular cabinet meetings to discuss the use of data for budget planning.

Operate a budget planning system from March 1968 to August 1968, using SPLAN as the data processing component. This activity comprises the initial version of a budget planning system.

Purposes: Define output requirements for data processing component of a new version of SPLAN for the IBM 360/67 computer (SPLAN 360).

Identify decision points in budget planning process along with persons responsible for decisions.

Products: Output Requirements for SPLAN 360, August 1968; User's Guide for Administrators: SPLAN 360, October 1968.

C. SPLAN 360 STAGE--March 1968-March 1969

Activities: Design, produce, implement, document, and test SPLAN 360. This version will be programmed for a time-sharing system operating on the IBM 360/67.

Purpose: Provide a practical budget planning system for a school district, using programs that can be adapted to computers that will likely be available to the schools.

Products: A user's component consisting of data input forms and instructions for their use in budget planning, and a data processing component consisting of the necessary computer program components and a guide for operating the programs, March 1969.

IV. SPLAN Q-32, THE CURRENT OPERATING VERSION

A detailed description of SPLAN appears in SDC document TM-3362/003/00 dated 5 October 1967. This 47-page document describes the basic design, available functions, command language, and error messages of the system. The document

also includes directions for establishing dataphone connections, logging in, loading, and interacting with the Q-32 Time-Sharing System. Section II, above, presents a general description with examples of uses.

V. EVALUATION OF SPLAN

During the summer of 1967, SPLAN was used briefly to calculate the cost of several salary proposals for the Charter Oak Unified School District. The circumstances surrounding its use were such that the district also figured the costs by manual methods. This permitted a comparison between the totals produced by the computer-based system and the totals produced by manual methods. Table 1 shows the comparison. The totals are remarkably similar; the maximum difference--of slightly more than two percent--appears for Proposal C. Since all figures are estimates, one would have to wait until a specific proposal was selected and implemented, and actual costs accumulated, to compare the accuracy of a budget produced by SPLAN with one produced by manual methods.

A second comparison between the two systems can be made in terms of the amount of time needed to produce the two kinds of figures in Table 1. The hand calculations required about seven man-days of clerical time. Using SPLAN, the Charter Oak Superintendent, Dr. Frank Kittinger, duplicated this effort in about two hours at the district's teletype. In this time he was also able to cost out five more proposals to aid in his negotiations with the district salary committee. These are based on the committee's request that a new set of indices be used to figure salaries. Costing these additional proposals by hand methods would probably have required another seven to eight man-days of clerical time.

School district offices are often asked by county, state, and federal agencies for summary information about their personnel. For clerks, preparing such information, even when data are available in central files, is usually an onerous and time-consuming task; SPLAN is a tireless and rapid file clerk that can provide information representing any combination of data from its storehouse in a matter of seconds. Some examples of such "look-ups" appear below, along with reproductions of the actual message typed to the computer and the response sent back to the district office.

Example 1

Question:

How many special reading teachers do you have in your district and what is their average salary? (In the following examples the average salary is denoted by the system synonym "E-19".)

Computer message:

```
COUNT AVG SALARY WHERE JOB-TITLE EQ TEACHER AND SUBJECT-AREA EQ *
*READ AND ED-LEVEL EQ SPEC
```

Computer response:

3 ENTRIES

AVG E19 10060

Example 2

Question:

How many elementary teachers in your district earn an average salary in the range between $5750 - $6049?

Computer message:

COUNT WHERE JOB-TITLE EQ TEACHER AND ED-LEVEL EQ ELEM AND SALARY *
*GQ 5750 AND SALARY LQ 6049

Computer response:

12 ENTRIES

Example 3

Question:

How many part-time teachers do you have in your district?

Computer message:

COUNT WHERE JOB-TITLE EQ TEACHER AND FTE NQ 100 AND E15 NQ 1

Computer response:

3 ENTRIES

Example 4

Question:

How many high school principals are there in your district and what is their average salary?

Computer message:

COUNT AVG SALARY WHERE JOB-TITLE EQ (HS PRIN)

Computer response:

2 ENTRIES

AVG E19 13660

Example 5

Question:

How many elementary teachers in the district are on the first step and first column of the district's salary schedule?

Computer message:

COUNT WHERE JOB-TITLE EQ TEACHER AND ED-LEVEL EQ ELEM AND DEGREE *
*EQ B AND HOURS-PLUS LQ 19 AND STEP EQ 1

Computer response:

3 ENTRIES

SPLAN was available for interactive use by Charter Oak district personnel from a teletype console located in the business office. Most of the clerical staff received some orientation to the system and several clerks were given practice at the console. One clerk from the personnel office was intensively trained. In addition, the superintendent and his staff of three assistants each received about three hours training at the teletype console. The availability of time on the Q-32 computer was governed by a loose set of conventions that effectively resulted in a first-come, first-served arrangement and definitely favored highly experienced, aggressive users.

In the period between May 1967 and February 1968, SPLAN was used in connection with Charter Oak about 134 hours. At times, the program was used by Charter Oak personnel from the console in their office; at other times, it was operated from that location by SDC personnel. At still other times, SDC collected tasks at Charter Oak and accomplished the work at Santa Monica. Table 2 shows a distribution of the 134 hours of SPLAN use arranged according to location and user. These data are presented to aid in assessing the value of the interactive feature.

The data in Table 2 shows that of the 98 hours devoted to using SPLAN, almost 90 percent was by an SDC operator. These figures strongly suggest that the Charter Oak people did not find the interactive feature of SPLAN to be especially valuable. Because of the possibility that the amount of time of SPLAN use may not be an adequate indication of its value, a further analysis was made of the 12 hours' use logged by Charter Oak personnel. This analysis showed that only three to four hours was actually devoted to obtaining information from SPLAN; the remainder of the 12 hours was used to update the personnel records stored in the data base.

Table 2. Estimated Use of SPLAN
May 1967 - February 1968

Location	User	Hours Used	Activity
C.O.	SDC	22	Training of Charter Oak Personnel in Use of System
C.O.	C.O.	14	Self-Training
C.O.	C.O.	12	Budget Planning
C.O.	SDC	6	Budget Planning
SDC	SDC	80	Budget Planning
Total Hours Used		134	

A study of the extensive observational notes made at Charter Oak suggests three reasons for the district's apparent disinterest in SPLAN's interactive capability. The first reason generally restricted total use of the program--interactively or otherwise--and is dependent on Charter Oak's annual scheduling of budget planning activities. After a budget is officially adopted in August, the district normally does not begin work on a new budget until early in the next calendar year. The new budget is drafted, reviewed iteratively during the spring, and the draft is presented for the school board's information in May. The board's reaction is taken into account and the budget revised accordingly. During June and July, the district is given information to enable a more accurate prediction of income. This information can lead to further revisions, and if the original estimate of income was a drastic error, the board may have to be consulted again for guidance.

Unfortunately, the present installation of SPLAN at Charter Oak was accomplished in May 1967--too late to be used for planning the 1967-1968 budget. The use of SPLAN reflected in Table 2 was mainly directed to obtaining information about the people in the data base as illustrated in the exemplary "look-ups" above rather than to its use in the budget mode. There has not been to date, an opportunity to use SPLAN systematically for budget planning.

A second factor that contributed to restricting the interactive use of SPLAN was the mechanical problems associated with using the Time-Sharing System. Despite the fact that about 25 percent of Charter Oak's involvement with SPLAN was devoted to training (see Table 2), observations indicated a continued unwillingness to use the system because of anticipated failure and embarrassment. It is one thing to expect persons with a primary responsibility to operate the Time-Sharing System--such as SDC personnel--to persevere in spite of mechanical difficulties, but it is not reasonable to expect a clerk with other primary duties to behave in a similar way. It is even less reasonable to expect administrators to maintain patience with a machine that, to them, is a clerk-surrogate when it is much simpler to talk to a person. Until SPLAN's interactive capability can be used without the need for special skills, it is not a practical design feature and should be abandoned.

A third and probably underlying reason for not using SPLAN's interactive capability was a marked lack of urgency on the part of Charter Oak personnel to obtain information from the system. No situation was observed in which a delay of one to several days between a request for information and the production of a report was not tolerable. This tolerance was perhaps heightened by the mechanical difficulties experienced by Charter Oak when they used SPLAN, but a careful examination of the use made of information shows that practical response times are more realistically expressed in terms of days rather than seconds. The huge expense of maintaining a system that provides conversational speed responses--as provided by SPLAN interaction--is not supportable in the light of the Charter Oak experiences.

VI. PLANS FOR USING SPLAN FOR 1968-1969 BUDGET

Planning for the 1968-1969 budget at Charter Oak is currently beginning, and it is intended that SPLAN's capabilities will aid in the process. Figure 3 shows how the budget planning system will employ SPLAN. The personnel management function shown in the upper right is independent of the planning system except in that it is responsible for ensuring that the budget data base continually reflects the current status of personnel in the district. As people leave, are hired, transferred, etc., the personnel management function of the district must pass this information to the planning system so that the data become part of the plan under development.

As defined by the system, a budget plan consists of the simulated budget data base for the coming year. This data base contains descriptions of the personnel who will be aboard during that time, the salary factors used to describe them, the salary schedule and salary indices to be used in computing their pay, the expected pupil population, and the amounts of money allotted to budget lines not computed from personnel salaries. From this data base the system will produce reports on a regular (weekly) basis to assist administrators in their budget planning work.

It is expected that each week the district cabinet will review its current budget plan (see Figure 3). Any decisions to update the plan by adding, deleting, or transferring personnel, will be collected at this time. Prior to the next review, the system will be used to generate reports describing the new plan. The district can maintain as many different budget plans as it maintains different data bases. For example, Plan A may represent a "bare-bones" budget with no added personnel and minimal salary increases; Plan B may reflect the cost of a proposed salary policy designed to attract and keep high quality teachers.

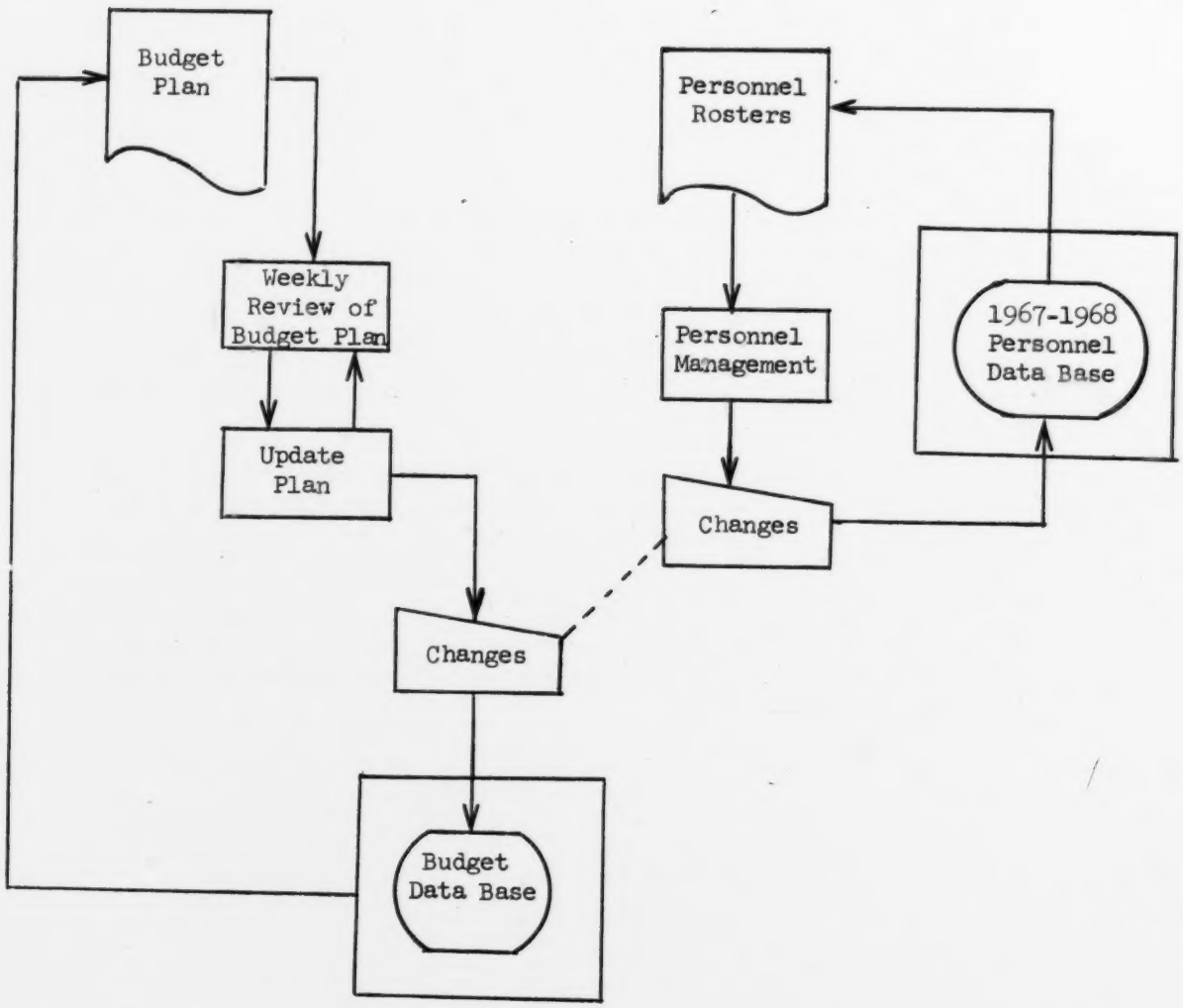

Figure 3. Budget Planning System Using SPLAN